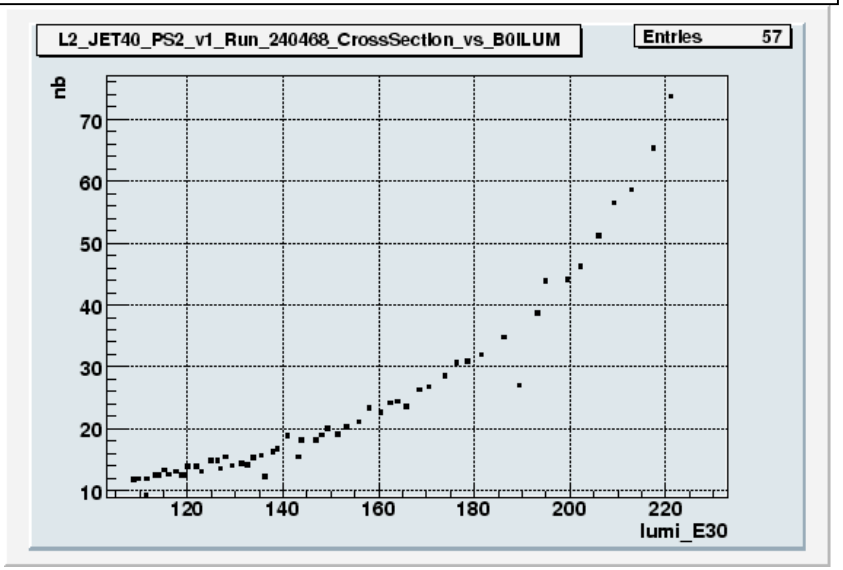
# *Level-2 Calorimeter Upgrade: Status Report*

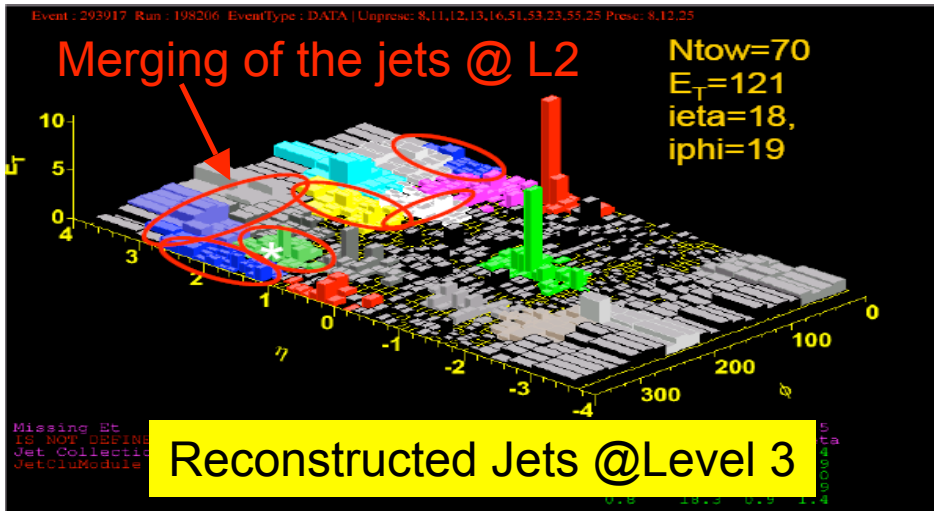
L2Cal Team
Chicago, Fermilab, Madrid, Padova, Penn, Pisa, Purdue

# Motivation

1. At high lumi, large Increase of the jet/Met based trigger cross sections.
   ⇒ Heavily prescaled search triggers.
2. Decrease of the multi-jets trigger efficiency.

CrossSection Level 2 Jet (Et>40 GeV)




Cause:

- L2 cluster algo (Pacman) merges True/fake jets together:
  - Low Et jets → high Et jets.
  - Multi-jet event → single jet event.

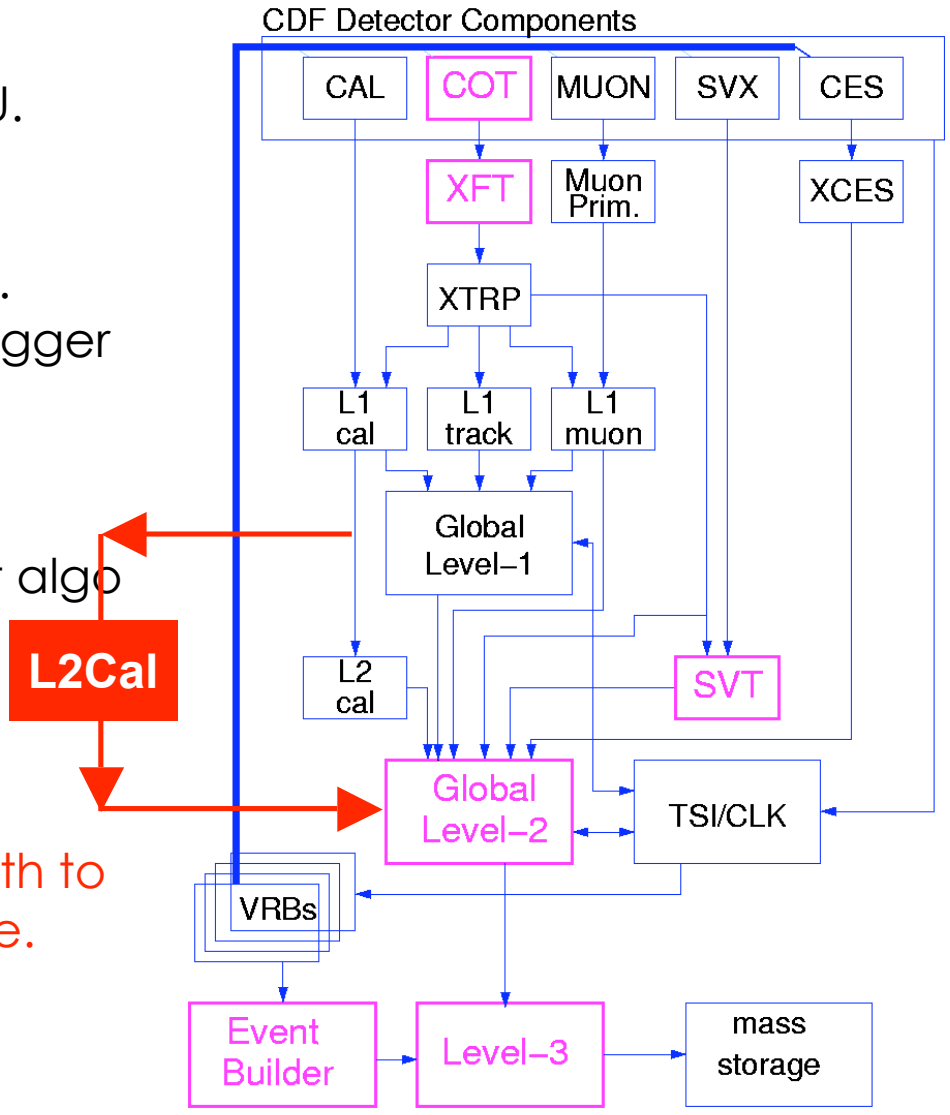
# L2Cal upgrade solution

1. Calorimeter trigger tower infos available to the L2 decision CPU.

2. New algorithm in L2 CPU:
   - Jet clustering (cone-based).
   - Met calculation using the trigger tower energy info at the maximum resolution.

3. Possibility to implement different algo in the CPU (angular cuts, SVT matching..).

Install parallel L2CAL hardware path to be tested in fully parasitic mode.

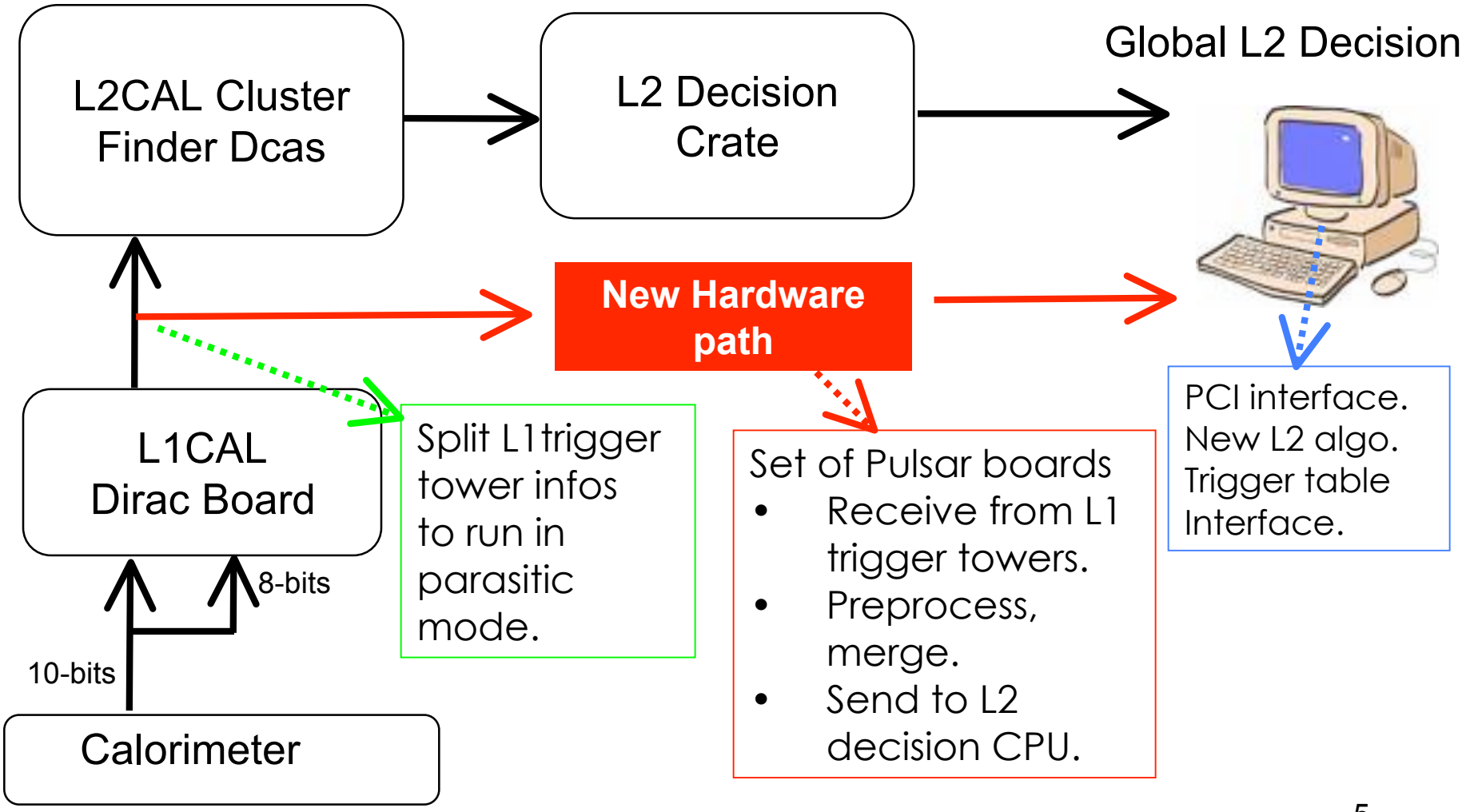


# L2Cal Team

**Project approved on September 14th 2006**
***"As vital for preserving and improving the sensitivity for Higgs searches"***

| | |
|---|---|
| project leader | Vadim Rusu (Chicago U.) |
| technical coordinator | Laura Sartori (EU OIF- INFN Pisa) |
| Respons. firmware delle Pulsar | Marco Piendibene (art. 23 – INFN Pisa) |
| Respons. Algoritmi sulla CPU | Gene Flanagan (Pardue U.) |
| Respons. Filar e unpacking dati | Anadi Canepa (Pen U.) |
| Respons. Tests mezzanine/Pulsars | Lucas Rogondino (laureando INFN-Pisa) |
| Respons. Monitoring sistema | Giorgio Cortiana ( INFN-Padova) |
| Respons. Readout | Massimo Casarsa (contratto Fermilab) |
| Respons. Simulazione nuovo L2 | Simone Donati (art. 23 INFN-Pisa) |
| Prod. mezzanine | U. of Chicago (Laura supervision) |
| Prod. Pulsars | INFN Pisa (Paola supervision) |
| Cavi & Meccanica di supporto | U. of Chicago (Henry supervision) |
| Test Produzione ed installazione | Virginia Greco,L. RogondinoINFN-pisa |
| Cosultants | Paola & Ted Liu |

# New system overview



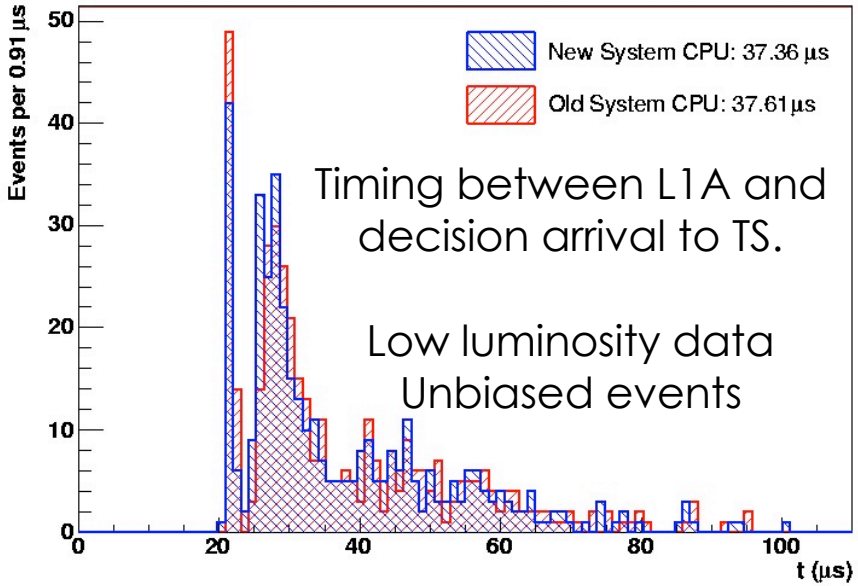
# Status

- Hardware:
  - All in place and tested.
- Interface Software:
  - Code for decision interface, finalized;
    - ready to build trigger tables for L2Cal.
- Clustering Software:
  - Finalized.
- FER & Monitoring:
  - Almost finalized.


System successfully run in parasitic mode at the end of store and in between stores.

*Next, compare decision between main and upgraded system.*

L2Cal upgrade is close to completion. (scheduled by end of May)



# What we can gain by the upgrade?

- Better estimate of Met.

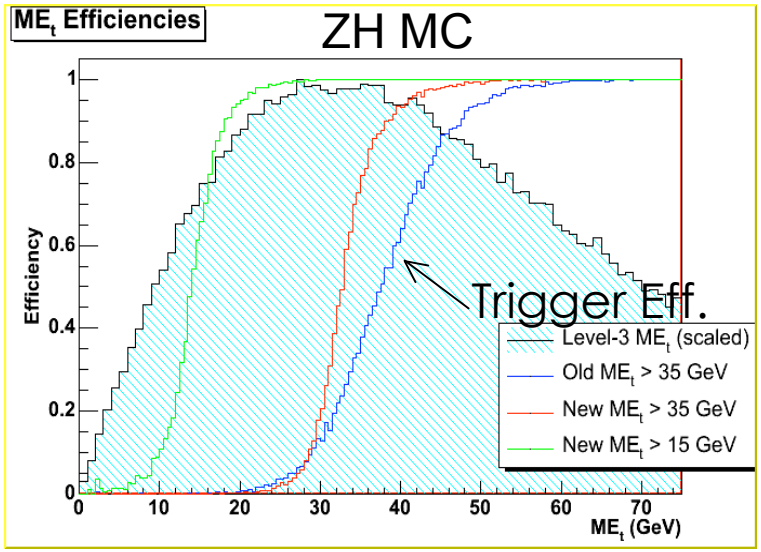
- Better estimate of the cluster Et & position at L2 :

  - ➢ Reduce trigger rate by rejecting more junk (save bandwidth → keep triggers alive at high lumi)

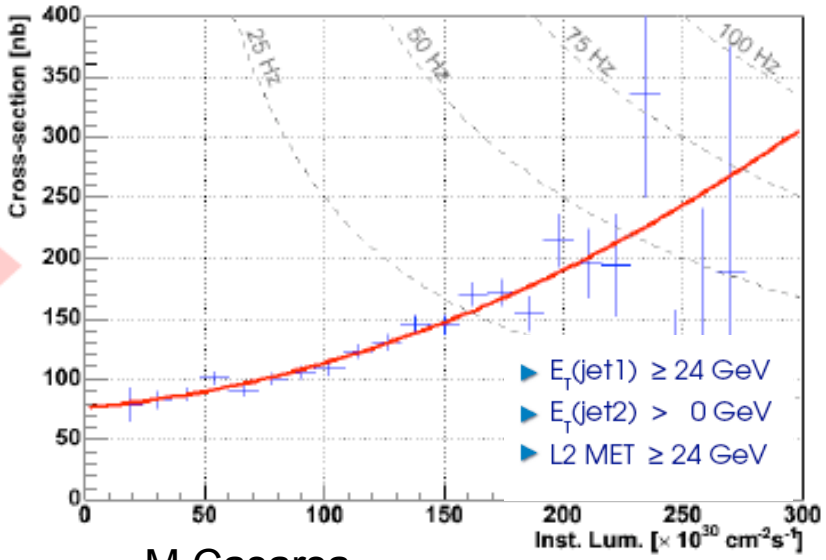
  - ➢ Improve Efficiency⇒ improve acceptance

- Could implement dijet mass cut, angular cuts, SV matching, isolation, etc.

⇒ Higgs Trigger Task Force Studies




M.Schmidt




M.Casarsa

# Backup

# Clustering Software

- Orders trigger towers in $E_T$ (using min $E_T$ = 0.125 GeV)
- Cluster $E_T$ in code around the seed $E_T > E_{T,MIN}$ GeV ( $\Delta R$ = 0.7)
- Flag towers as used
- Sort clusters in $E_T$ (max 20)
- Cluster $\varphi$ and $\eta$ are weighted by $E_T$

# Clustering Pass

| | | |
|---|---|---|
| Pass 0 | Seed | 2 GeV |
| | Shoulder | 1 GeV |
| | One tower per cluster | |
| Pass 1 | Seed | 8 GeV |
| | Shoulder | 7.5 GeV |
| Pass 2 | Seed | 3 GeV |
| | Shoulder | 1 GeV |
| Pass 4 (alpha) | Seed | From Pass 1 Had/Em < 0.125 |
| | Energy from Pass 0<br>Had/Em < 0.125<br>Central: 1φ wedge; ±1 η wedge<br>Plug: 3 x 3 box<br>No crossing in η | |

**New Clustering Algorithm**

- Pass 0 not changed
- Pass 1 replaced by Pass 4
- Pass 2 cone based – NEW
- Pass 4 not changed

**New Isolation Algorithm**

- Starts from the seed position
- Finds iso 3x3 and (4)3x4
- Uses the smallest of the 5 sums
- Calculated for Pass 1